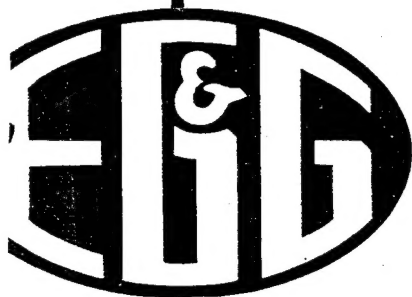


EGG  
B-2063

R.A.E.



EDGERTON, GERMESHAUSEN & GRIER, INC.

FIREBALL CALCULATIONS  
SHOT HUMBOLDT  
OPERATION HARDTACK PHASE II  
PROJECT 15.1

DISTRIBUTION STATEMENT A

Approved for public release  
Distribution Unlimited

19960702 077

DISTRIBUTION STATEMENT A APPLIES  
PER NTPR REVIEW.

*Robert L. Kopp* DATE 4/25/96

REPORT NO. B-2063  
4 MARCH 1960

BOSTON, MASSACHUSETTS • LAS VEGAS, NEVADA  
SANTA BARBARA, CALIFORNIA

# DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.**



Defense Nuclear Agency  
6801 Telegraph Road  
Alexandria, Virginia 22310-3398



ISST

29 May 1996

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER  
ATTENTION: OCD/MR. BILL BUSH

SUBJECT: Documents for DTIC System

There is no record of your office receiving the following reports:

EGG-B-2064 (4 March 1960)  
Fireball Calculations Shot  
Wrangell Operation Hardtack  
Phase II, Project 15.1

EGG-B-2063 (4 March 1960)  
Fireball Calculations Shot Humboldt  
Operation Hardtack Phase II  
Project 15.1

Both documents are now approved for public release.

Therefore, we are transmitting copies for inclusion into the DTIC system, if not found there.

Enclosure:  
A/S

*Ardrith Jarrett*  
ARDITH JARRETT  
Chief, Technical Support

DTIC QUALITY INSPECTED 4

FIREBALL CALCULATIONS  
SHOT HUMBOLDT  
OPERATION HARDTACK, PHASE II  
PROJECT 15.1

Report No. B-2063  
4 March 1960

Prepared by

J. E. Campbell  
J. E. Campbell

Approved by

D. F. Seacord, Jr.  
D. F. Seacord, Jr.

EDGERTON, GERMESHAUSEN & GRIER, INC.  
Boston, Mass.      Santa Barbara, Calif.      Las Vegas, Nev.



## FIREBALL CALCULATIONS - SHOT HUMBOLDT

### 1.0 INTRODUCTION

Shot Humboldt was a thirty-foot tower shot sponsored by LRL and detonated on 29 October 1958 in Area T-3V of the Nevada Test Site at 0645 FST.

The fireball yield was  $3.3 \text{ tons} \pm 0.3 \text{ ton}$ .

### 2.0 CAMERA INSTRUMENTATION AND OPERATION

Photographic coverage of fireball growth was provided by four high-speed Eastman cameras, two each at Station 3-357 (Transporter No. 3) and Station 3-358 (White Truck No. 2). Two Rapatronic cameras were located at each of these stations to record early fireball growth. In addition, a 15,000 frame-per-second EG&G Framing camera was used, located at Station 3-358 (6 x 6 No. 1). All cameras produced good records of this low-yield tower shot.

Station locations together with burst location are shown in Figure 1. Figure 2 is a summary of the survey data.

### 3.0 RESULTS

Application of phi-comparison (EG&G Report No. B-1869) indicates a yield of  $3.3 \text{ tons} \pm 0.3 \text{ ton}$  for Shot Humboldt.

An air density of 1.097 grams per liter was used in the yield calculations, based on a pressure of 885 millibars, a temperature of  $7.4^{\circ}\text{C}$ , and a relative humidity of 46% at the height of the device at shot time.

The following table shows the comparison shots and the Humboldt yield obtained by the phi-comparison.

Comparison Shot	Humboldt Yield (Tons)
<u>Air Drop</u>	
Osage	3.35
Ranger A	3.17
Buster B	3.20
Wasp	3.41
Wasp <sup>†</sup>	3.41
Ranger E	3.25
<u>Balloon</u>	
Rushmore	3.51
Hidalgo	3.36
Lea	3.46
<u>Tower</u>	
Post	3.26
UK-3	3.25
Chaves	3.53
Hornet	3.33
Moth	3.19
Quay	3.24
$\bar{W} = 3.3 \text{ tons}$	

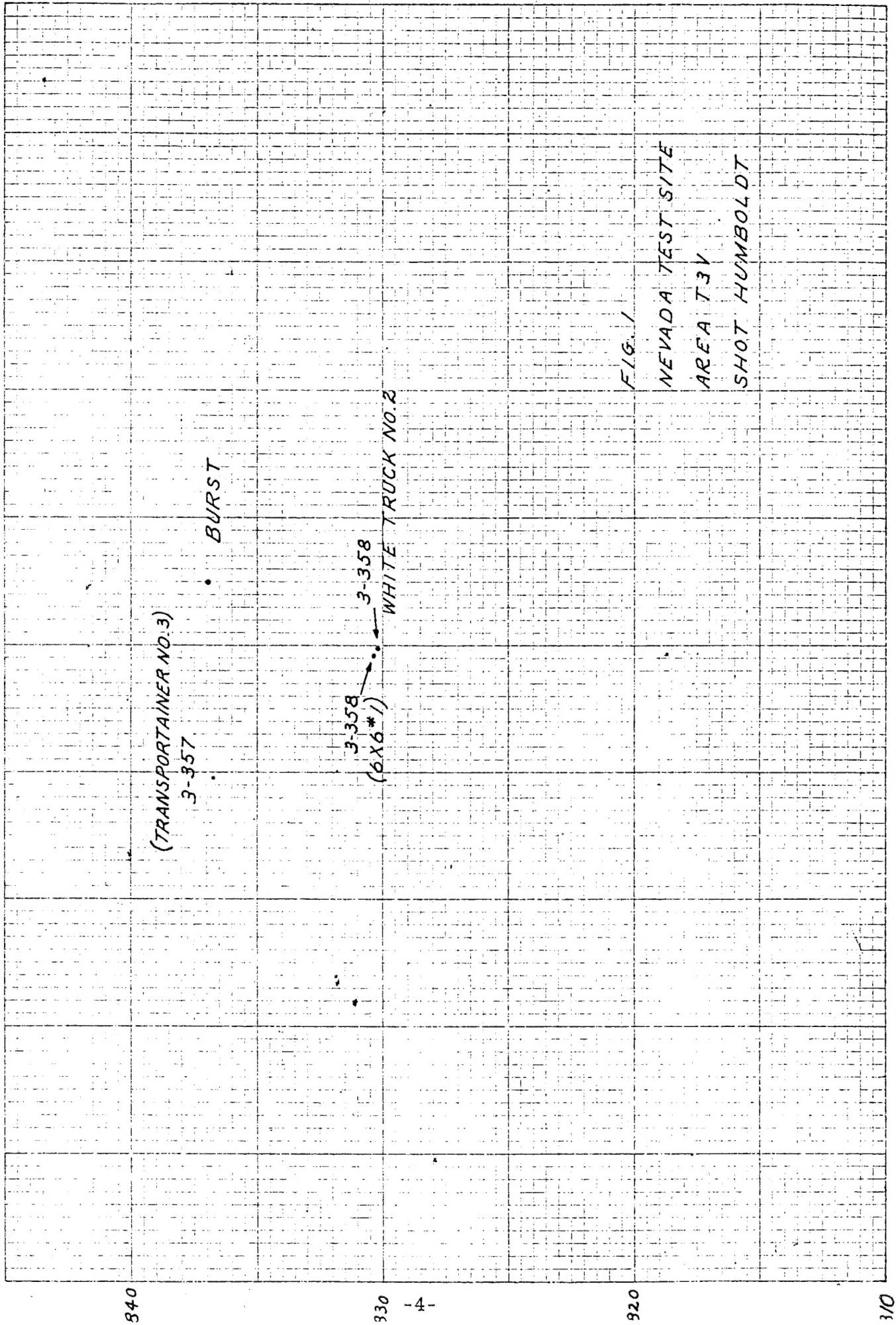
Diameter vs time and phi vs time plots are shown in Figs. 3 and 4.

The following data sheets are included for each film:

- Photo Plan and Photo Loading Chart
- Camera Data and Calculation Sheet
- Diameter Measurement Sheet
- E-102 Print-Out Sheet of D, t, and  $\phi$

The zero-frame times of the Eastman and Framing camera records were determined by comparison with the Rapatronic diameter-time data.

Appendix A contains photographic examples of the Humboldt fireball.



HUMBOLDT

# DATA

GZ STA. 73V

[illegible]

FORM E17 (1-55 500)

NAME ANALYSIS

EDGERTON, GERMESHAUSEN & GRIER INC.

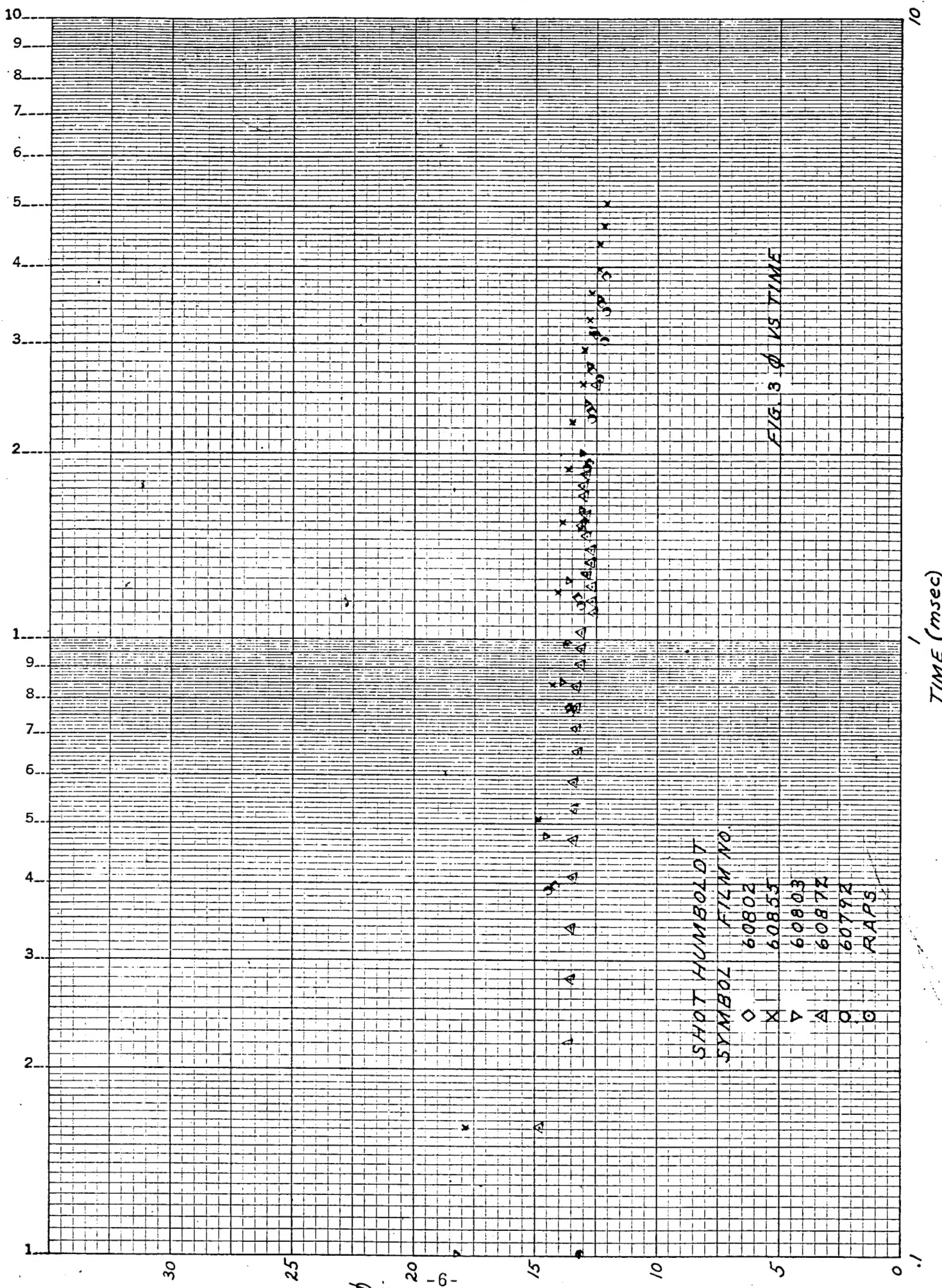


FIG 3  $\phi$  VS TIME

TIME (msec)



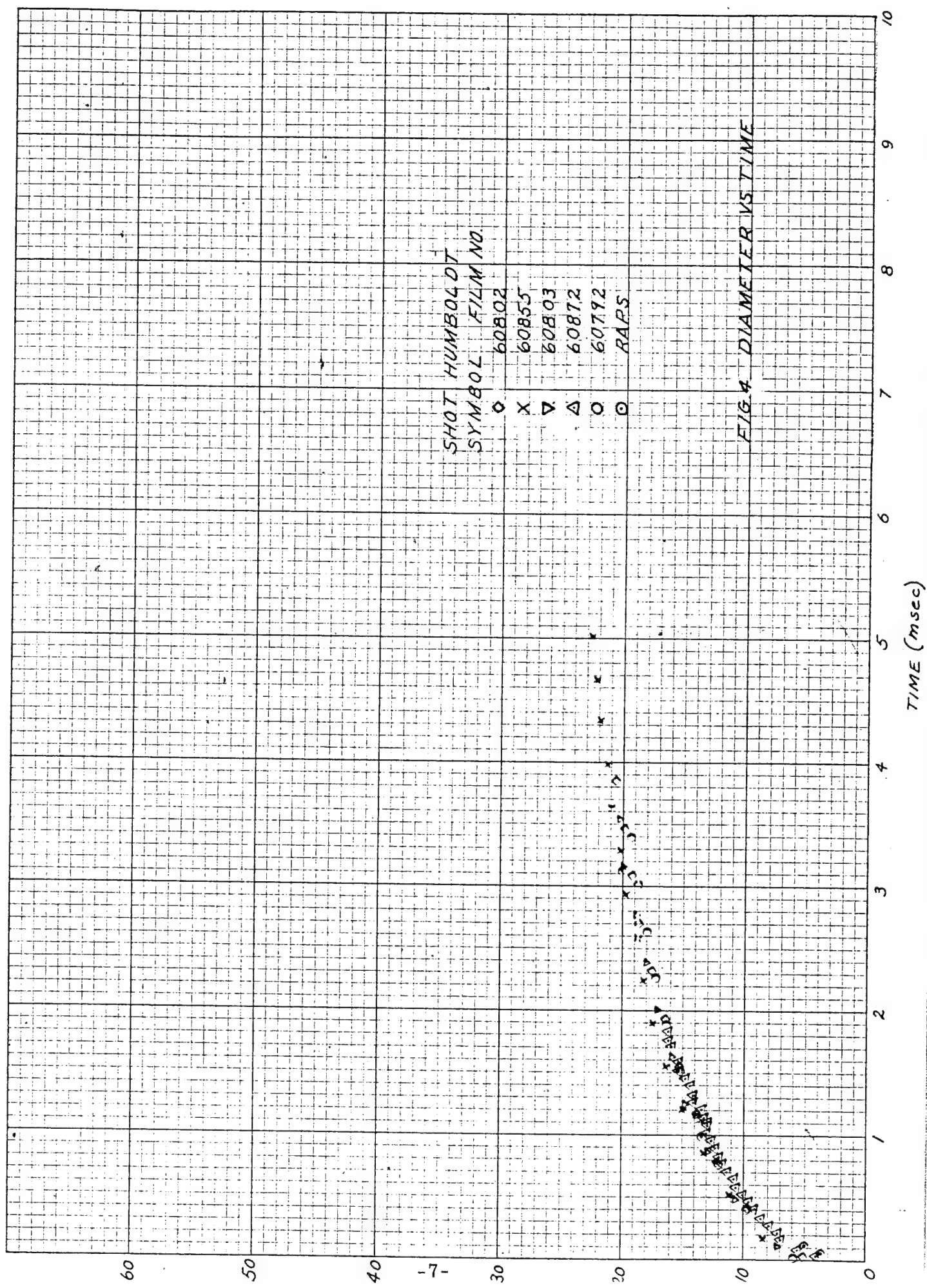


Table I

Hardtack Phase II, Humboldt  
Fireball Camera Distribution

Station	Camera	Qualitative Functioning
3-357 Transportainer No. 3	E-33	Record
	E-1	Record
	R-34	Record
	R-30	Record
3-358 White Truck No. 2	E-11	Record
	E-5	Record
	XR-3	Record
	R-4	Record
3-358 6 x 6 No. 1	Framing	Record

Table II

Hardtack Phase II, Humboldt  
Average Diameter vs Time

Time (m sec)	Diameter (meters)
0.5	10.5
1.0	13.5
1.5	15.5
2.0	17.0
2.5	18.5
3.0	19.5
3.5	20.0
4.0	21.0



Table III  
Hardtack Phase II, Humboldt

Rapatronic Summary

Station	Film No.	Camera No.	Horizontal Range (m)	F. L. (mm)	Diameter (m)	Time (ms)
3-357	60851	R-34	2339.3	479.03	13.67	0.99
	60852	R-30	2339.3	479.30	3.75	0.05
3-358	60794	XR-3	2163.9	476.76	5.21	0.10
	60795	R-4	2163.9	477.82	20.17	3.15



# PHOTO LOADING CHART

**STATION** 3-358 6x6 #1

**EVENT** HUMBOLDT

DATE 10/29/58[illegible][illegible]

REMARKS

FINAL



# PHOTO LOADING CHART

STATION 3-358 WHITE TRUCK No. 2 EVENT HUMBOLDT DATE 10/29/58

DATE 10/29/58[illegible]

DATE FILM LOADED-

DATE CAMERA LOADED.

DATE EXPOSED

REMARKS

## FINAL

**FORM E-40**

**EDGERTON, GERMESHAUSEN & GRIER, INC.**

STATION NO. 3-357

STATION TYPE TRANSPORTAINER No. 3

DISTANCE GZ 7675.1 ft

DISTANCE OBJECT 7675.3 ft

BRG 88° 22'

DIFF. 218

GZ 836 984

687 378

4 054 \*

EVENT HUMBOLDT

GZ STA. 73V

DATE 10/29/58

POSTED 10/31/58

# PHOTO PLAN

CAMERA		LENS		FIELD TARGET H/V	AIMING		POWER		MARKER		DELAY $\mu$ S	FILM	PUR-POSE	REMARKS
NO.	NOM SPD.	RACK POS.	FOC. MM	S/N	FILTER	OBJECT	H	V	VOLTS	SHUT RHEO.	TIME ON/OFF	TYPE	S/N	
E-33	2500	B-2	305	784702	ND-1	F.B.	0°00'	0°27'	120DC	40/80	-1.5/+1.5	200	4	MF 15.1
E-1	2500	B-1	500	C73377	W-12	F.B.	0°00'	0°4'	120DC	40/80	-1.5/+1.5	200	2	MF 15.1
M-2	100	A-1	50	MA4481	W-12	CLOUD	0°00'	7°48'	120DC	170°	-5/+30	200	4	FX 15.1
R-34	400	A-2	480	773948	=	F.B.	0°00'	0°27'	115AC 24DC	BULB	=	FM	11	RP 15.1 1000 $\mu$ S delay
R-30	400	A-3	480	773953	ND-1	F.B.	0°00'	0°21'	115AC 24DC	BULB	=	FM	11	RP 15.1 50 $\mu$ S delay
60	64	A-1	25	69261	=	DOC.	0°00'	7°58'	24DC	133°	-5/+30	=	=	D 15.1
128	64	A-1	18.5	12318	=	DOC.	0°00'	0°24'	24DC	133°	-5/+30	=	=	D 15.1
ACTUAL RAP DELAYS														
						R-34	968.4	4 $\mu$ sec +	20 $\mu$ sec	half coil delay				
						R-30	53.9	4 $\mu$ sec +	2 $\mu$ sec	half coil delay				

REMARKS \* INCLUDES 30 ft HEIGHT OF TOWER



# PHOTO LOADING CHART

STATION 3-357 TRANSPORTER NO.3 **EVENT** HUMBOLDT

DATE 10/29/58[illegible]

	DATE	FILM	LOADED	_____	DATE	CAMERA	LOADED	_____	DATE	EXPOSED	_____
	DATE	FILM	LOADED	_____	DATE	CAMERA	LOADED	_____	DATE	EXPOSED	_____

REMARKS

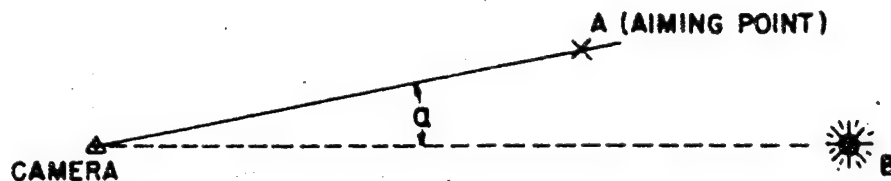
FINAL

**FORM E-40**

**EDGERTON, GERMESHAUSEN & GRIER, INC.**

# CAMERA DATA & CALCULATIONS

FILM NO. 60794	STATION NO. <sup>WHITE TRUCK NO. 2</sup> 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. XR-3	EQ. AP.		DATE: 12/1/58



HORIZONTAL  
PROJECTION

A.  $R^{\circ}A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^{\circ} 00'$	$\beta = 0^{\circ} 45'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R^{\circ}A = \boxed{2163.93 \text{ m}}$

B. FOCAL LENGTH 476.76 mm (774695)

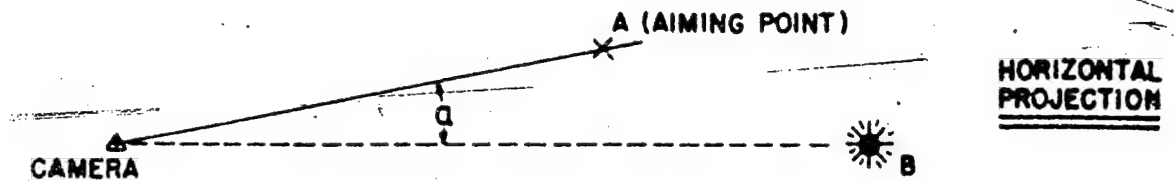
C. MAGNIFICATION FACTOR (meters/in.) 115.29

D. ZERO TIME CORRECTION 0.10 msec delay



# CAMERA DATA & CALCULATIONS

FILM NO. 60795	STATION NO. <sup>WHITE TRUCK NO. 2</sup> 3-358	TEST HUMBOLDT	CALCULATED BY: JE.
CAMERA NO. R-4	EQ. AP.		DATE: 12/1/58



A.  $R^0_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 45'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R^0_A = \boxed{2163.93 \text{ m}}$

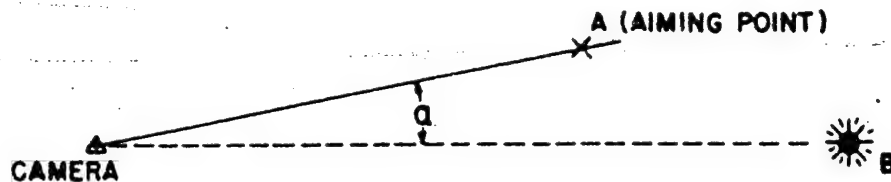
B. FOCAL LENGTH 477.82 mm (773952)

C. MAGNIFICATION FACTOR (meters/in.) 115.03

D. ZERO TIME CORRECTION 3.15 msec delay

# CAMERA DATA & CALCULATIONS

FILM NO. 60851	STATION NO. 3-357	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. R-34	EQ. AP.		DATE: 12/1/58



**HORIZONTAL  
PROJECTION**

A.  $R^{\circ}_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^{\circ} 00'$	$\beta = 0^{\circ} 27'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.99997$	$H_C = 4046 \text{ ft}$
$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00785$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2339.3 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^{\circ}_A = \boxed{2339.3 \text{ m}}$

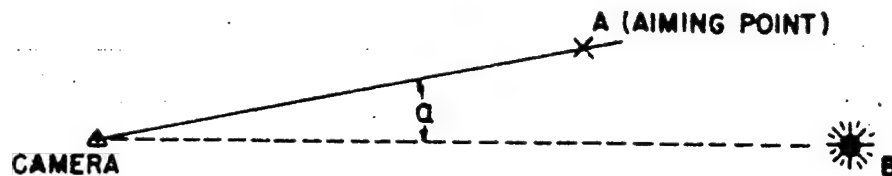
B. FOCAL LENGTH 479.03 mm (773948)

C. MAGNIFICATION FACTOR (meters/in.) 124.04

D. ZERO TIME CORRECTION 0.99 msec delay

# CAMERA DATA & CALCULATIONS

FILM NO. 60852	STATION NO. 3-357 <small>TRANSPIRATOR No. 3</small>	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. R-30	EQ. AP.		DATE: 12/1/58



**HORIZONTAL  
PROJECTION**

A.  $R^0_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 27'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.99997$	$H_C = 4046 \text{ ft}$
$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00785$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2339.3 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^0_A = \boxed{2339.3 \text{ m}}$

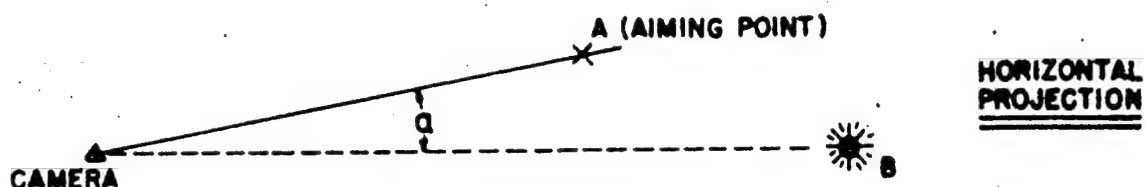
B. FOCAL LENGTH 479.30 mm (773953)

C. MAGNIFICATION FACTOR (meters/in.) 123.97

D. ZERO TIME CORRECTION 0.05 msec delay

# CAMERA DATA & CALCULATIONS

FILM NO. 60855	STATION NO. <sup>WHITE TRUCK NO. 2</sup> 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-5	EQ. AP.		DATE: 10/29/58



A.  $R^0_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 45'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R^0_A = \boxed{2163.93 \text{ m}}$

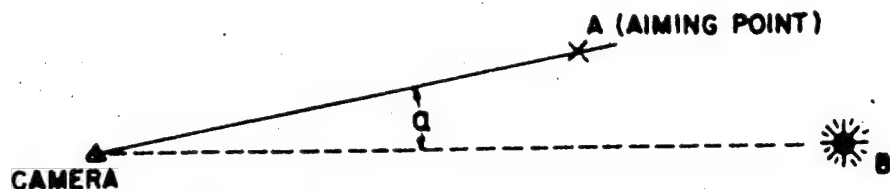
B. FOCAL LENGTH 250.2 mm (876312)

C. MAGNIFICATION FACTOR (meters/in.) 219.68

D. ZERO TIME CORRECTION 0.16 msec

# CAMERA DATA & CALCULATIONS

FILM NO. 60855	STATION NO. <sup>WHITE TRUCK NO. 2</sup> 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-5	EQ. AP.		DATE: 10/29/58



A.  $R\%_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 45'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.999914$	$H_C = 3997 \text{ ft}$
$CB_h = 2163.9 \text{ m}$	$\sin \beta = 0.013090$	$\Delta H = 57 \text{ ft} = 17.4 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2163.7 \text{ m}$	$\Delta H \sin \beta = 0.23 \text{ m}$	$R\%_A = \boxed{2163.93 \text{ m}}$

B. FOCAL LENGTH  $250.2 \text{ mm (876312)}$

C. MAGNIFICATION FACTOR (meters/in.)  $219.68$

D. ZERO TIME CORRECTION  $0.16 \text{ msec}$

### DIAMETER MEASUREMENTS

**SHOT HUMBOLDT**

FILM NO. 60855

[illegible]

READ BY GGO JEC TYPED BY

DATE	10/29/58	DATE
------	----------	------

REMARKS:

# FIREBALL CALCULATIONS

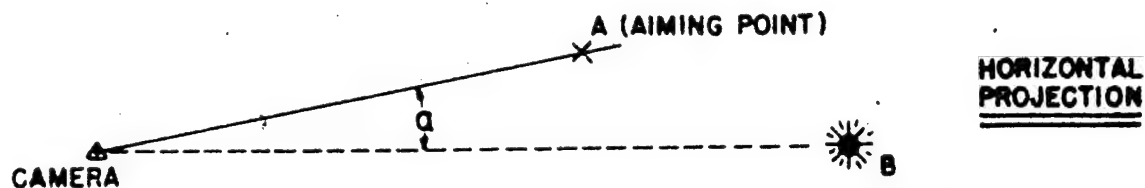
SHOT HUMBOLDT FILM NO. 60855

DATE                     

D	t	ln D	Int	$t^{2/5}$	$\phi$
8.53	.15	2.14766	1.83250 -	.480463	177.53
11.99	.51	2.42384	.67335 -	.763882	147.79
13.38	.85	2.59377	16245 -	.937085	142.78
15.05	1.20	2.71145	18225	10.75626	139.91
16.49	1.55	2.80283	43833	11.91642	138.38
17.55	1.90	2.86511	64187	12.92721	135.76
18.50	2.25	2.91780	81086	13.83128	133.75
19.03	2.59	2.94604	95158	14.63210	130.05
19.86	2.94	2.98970	107837	15.39373	129.01
20.43	3.29	3.01699	119090	16.10207	126.87
21.07	3.64	3.04782	129204	16.76684	125.66
21.45	3.99	3.08568	138386	17.39412	123.31
22.06	4.75	3.09371	147024	18.00558	122.51
22.51	4.68	3.11390	154733	18.53981	121.41
22.25	5.03	3.12829	161542	19.08217	119.74

# CAMERA DATA & CALCULATIONS

FILM NO. 60802	STATION NO. 3-357	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-33	EQ. AP.		DATE: 12/1/58



A.  $R^0_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = 0^\circ 27'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 0.99997$	$H_C = 4046 \text{ ft}$
$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00785$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2339.3 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^0_A = \boxed{2339.3 \text{ m}}$

B. FOCAL LENGTH 306.9 mm (784702)

C. MAGNIFICATION FACTOR (meters/in.) 193.6

D. ZERO TIME CORRECTION 0.01 msec



## DIAMETER MEASUREMENTS

**SHOT** HUMBOLDT

FILM NO. 60802

[illegible]

READ BY LW JEC TYPED BY

DATE 10/29/58 DATE

REMARKS:

# FIREBALL CALCULATIONS

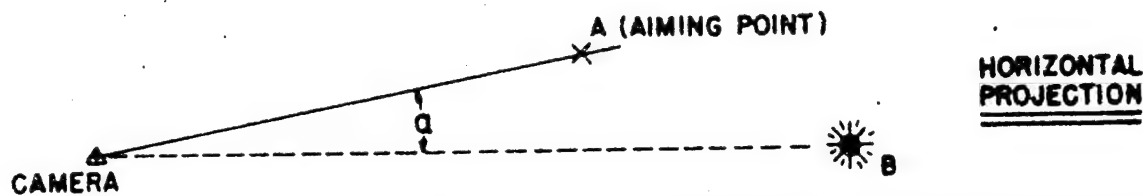
SHOT HUMBOLDT FILM NO. 60802

DATE \_\_\_\_\_

D	t	ln D	Int	t <sup>2/5</sup>	φ
5.23	.01	1.65439	4.60509	.159064	328.79
9.79	.40	2.28133	9.1621	.693164	141.23
12.30	.78	2.50955	248.44	.905399	135.85
14.04	1.17	2.64195	156.93	10.64784	131.85
15.38	1.55	2.73314	438.33	11.91642	129.06
16.55	1.94	2.80646	662.69	13.03533	126.96
17.69	2.33	2.87305	845.79	14.02588	126.12
18.75	2.71	2.93175	996.88	14.89965	125.90
19.50	3.10	2.97042	1131.39	15.72327	124.01
20.13	3.48	3.00220	1247.07	16.46795	122.23
20.60	3.87	3.02527	1353.32	17.18293	119.88

# CAMERA DATA & CALCULATIONS

FILM NO. 60803	STATION NO. 3-357	TEST HUMBOLDT	CALCULATED BY: JEC
CAMERA NO. E-1	EQ. AP.		DATE: 12/1/58



A.  $R^0_A = CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$

$\alpha = 0^\circ 00'$	$\beta = -0^\circ 4'$	$H_B = 4054 \text{ ft}$
$\cos \alpha = 1.00000$	$\cos \beta = 1.00000$	$H_C = 4046 \text{ ft}$
$CB_h = 2339.4 \text{ m}$	$\sin \beta = 0.00116$	$\Delta H = 8 \text{ ft} = 2.44 \text{ m}$
$CB_h \cos \alpha \cos \beta = 2339.4 \text{ m}$	$\Delta H \sin \beta = 0.00 \text{ m}$	$R^0_A = \boxed{2339.4 \text{ m}}$

B. FOCAL LENGTH 541.6 mm (C73377)

C. MAGNIFICATION FACTOR (meters/in.) 109.7

D. ZERO TIME CORRECTION 0.10 msec

## DIAMETER MEASUREMENTS

**SHOT HUMBOLDT**

FILM NO. 60803

[illegible]

READ BY \_\_\_\_\_ plw rh

TYPED BY

**DATE** ~~10/29/58~~ 10/29/58

DATE \_\_\_\_\_

REMARKS:

# FIREBALL CALCULATIONS

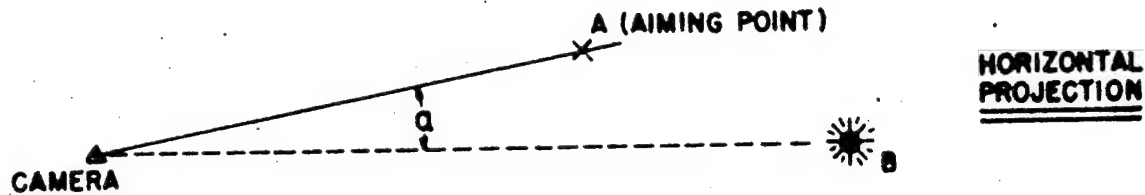
SHOT HUMBOLDT FILM NO. 6 0803

DATE \_\_\_\_\_

D	t	ln D	Int	$t^{2/5}$	$\phi$
7.26	.10	1.08234	2.30251 -	.308119	18235
1079	.48	2.37856	73394 -	745590	14471
1305	.86	2.56878	15075 -	941480	13861
1485	1.25	2.69807	22310	1093345	13582
1596	1.63	2.77016	48865	1215873	13126
1716	2.01	2.84265	69812	1322137	12978
1823	2.40	2.90311	87539	1419290	12844
1908	2.78	2.94866	102239	1505247	12675
2005	3.17	2.99822	115373	1586440	12638
2050	3.55	3.02040	126700	1669971	12349

# CAMERA DATA & CALCULATIONS

50792	STATION NO. <sup>WHITE TRUCK NO. 2</sup> 3-358	TEST HUMBOLDT	CALCULATED BY: JEC
E-11	EQ. AP.		DATE: 12/1/58



$$= CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$$

	$\beta = 0^\circ 29'$	$H_B = 4054 \text{ ft}$
00000	$\cos \beta = 0.99996$	$H_C = 3997 \text{ ft}$
53.9 m	$\sin \beta = 0.00844$	$\Delta H = 57 \text{ ft} = 17.37 \text{ m}$
$\cos \beta = 2163.8 \text{ m}$	$\Delta H \sin \beta = 0.1 \text{ m}$	$R^0/A = 2163.9 \text{ m}$

AL LENGTH 305.9 mm (784691)

MAGNIFICATION FACTOR (meters/in.) 179.68

TIME CORRECTION 0.01 msec

## DIAMETER MEASUREMENTS

**SHOT HUMBOLDT**

FILM NO. 60792

[illegible]

READ BY plw jc rh TYPED BY                     

DATE 10/29/58 DATE

REMARKS :

# FIREBALL CALCULATIONS

SHOT HUMBOLDT FILM NO. 60792

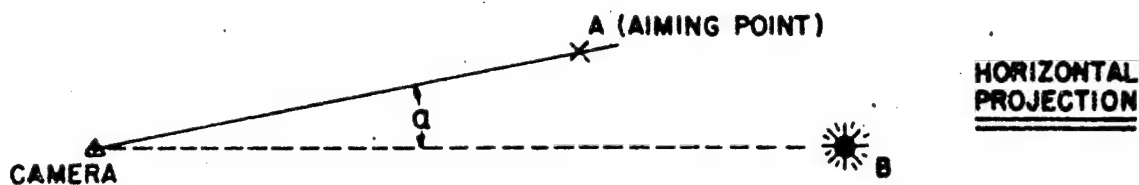
DATE \_\_\_\_\_

b	t	ln D	Int	$t^{2/3}$	$\phi$
6.00	.01	1.79168	4.60509 -	.159064	37.720
9.86	.39	2.28844	941.53 -	6.86180	143.69
12.23	.76	2.50384	274.44 -	8.96034	136.49
13.85	1.14	2.62832	130.95	10.53776	131.43
15.32	1.51	2.72923	412.18	11.79242	129.91
16.50	1.89	2.80343	636.59	12.89997	127.90
17.42	2.27	2.85768	819.71	13.88031	125.50
18.16	2.64	2.89926	970.70	14.74446	123.16
18.90	3.02	2.93918	1105.23	15.55961	121.46
19.57	3.40	2.97400	1223.81	16.31539	119.94



# CAMERA DATA & CALCULATIONS

0872	STATION NO. <sup>3-358</sup> <sub>(6x6 #1)</sub>	TEST <i>HUMBOLDT</i>	CALCULATED BY: <i>JEC</i>
FRAMING	EQ. AP.		DATE: <i>1/29/60</i>



$$CB_h \cos \alpha \cos \beta + (H_B - H_C) \sin \beta$$

0'	$\beta = 0^\circ 29'$	$H_B = 4054 \text{ ft}$
10000	$\cos \beta = 0.99996$	$H_C = 3997 \text{ ft}$
4.7 m	$\sin \beta = 0.00844$	$\Delta H = 57 \text{ ft} = 17.37 \text{ m}$
$\cos \beta = 2164.6 \text{ m}$	$\Delta H \sin \beta = 0.1 \text{ m}$	$R^0/A = \boxed{2164.7 \text{ m}}$

L LENGTH

IFICATION FACTOR (meters/in.)

TIME CORRECTION *0.03 msec 1/2 fr*

## DIAMETER MEASUREMENTS

**SHOT HUMBOLDT**

FILM NO. 60872

[illegible]

READ BY JEC RCS

TYPED BY

DATE 1/29/60

DATE \_\_\_\_\_

REMARKS:

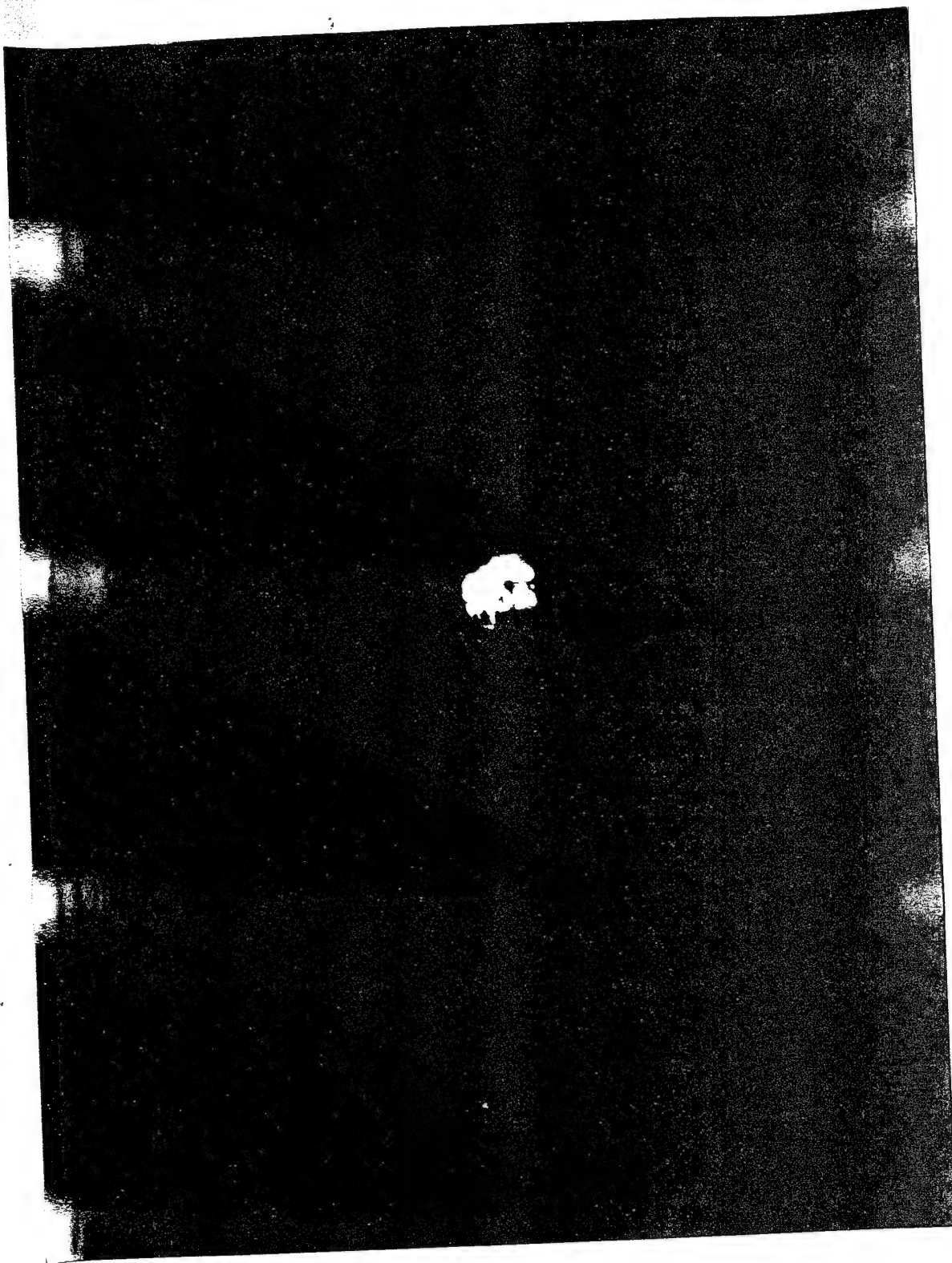
# FIREBALL CALCULATIONS

SHOT HUMBOLDT FILM NO. 60872

DATE \_\_\_\_\_

D	t	ln D	Int	$t^{2/5}$	$\phi$
4.16	.03	1.42559	3.50658 -	2.45999	16910
5.72	.09	1.74390	2.40787 -	3.81691	14985
7.13	.16	1.96427	1.83250 -	4.80463	14839
7.46	.22	2.00954	1.51418 -	5.45706	13670
8.14	.28	2.09683	1.27302 -	6.00969	13544
8.80	.34	2.17482	1.07877 -	6.49526	13548
9.41	.41	2.24181	.89152 -	7.00045	13441
9.91	.47	2.29349	.75498 -	7.39341	13403
10.39	.53	2.34083	.63490 -	7.75720	13393
10.85	.59	2.38410	.52770 -	8.09707	13399
11.19	.66	2.41404	.41559 -	8.46845	13213
11.73	.72	2.46208	.32854 -	8.76851	13377
12.14	.78	2.49645	.24844 -	9.05399	13408
12.37	.84	2.51523	.17429 -	9.32657	13263
12.66	.91	2.53842	.9424 -	9.63003	13146
12.98	.97	2.56340	.3046 -	9.87886	13139
13.35	1.03	2.59153	.2956	10.11896	13193
13.10	1.10	2.57261	.9524	10.38831	12610
13.55	1.16	2.60641	1.4834	10.61133	12769
13.77	1.22	2.62252	1.9879	10.82766	12717
14.38	1.28	2.66589	2.4683	11.03774	13028
14.33	1.34	2.66241	2.9268	11.24200	12746
14.74	1.41	2.69063	3.4363	11.47348	12847
15.11	1.47	2.71543	3.8532	11.66642	12951
15.60	1.53	2.74735	4.2534	11.85466	13159
15.55	1.60	2.74414	4.7008	12.06872	12884
16.24	1.72	2.78755	5.4238	12.42288	13072
16.48	1.78	2.80222	5.7666	12.59438	13085
16.53	1.85	2.80525	6.1521	12.79011	12924

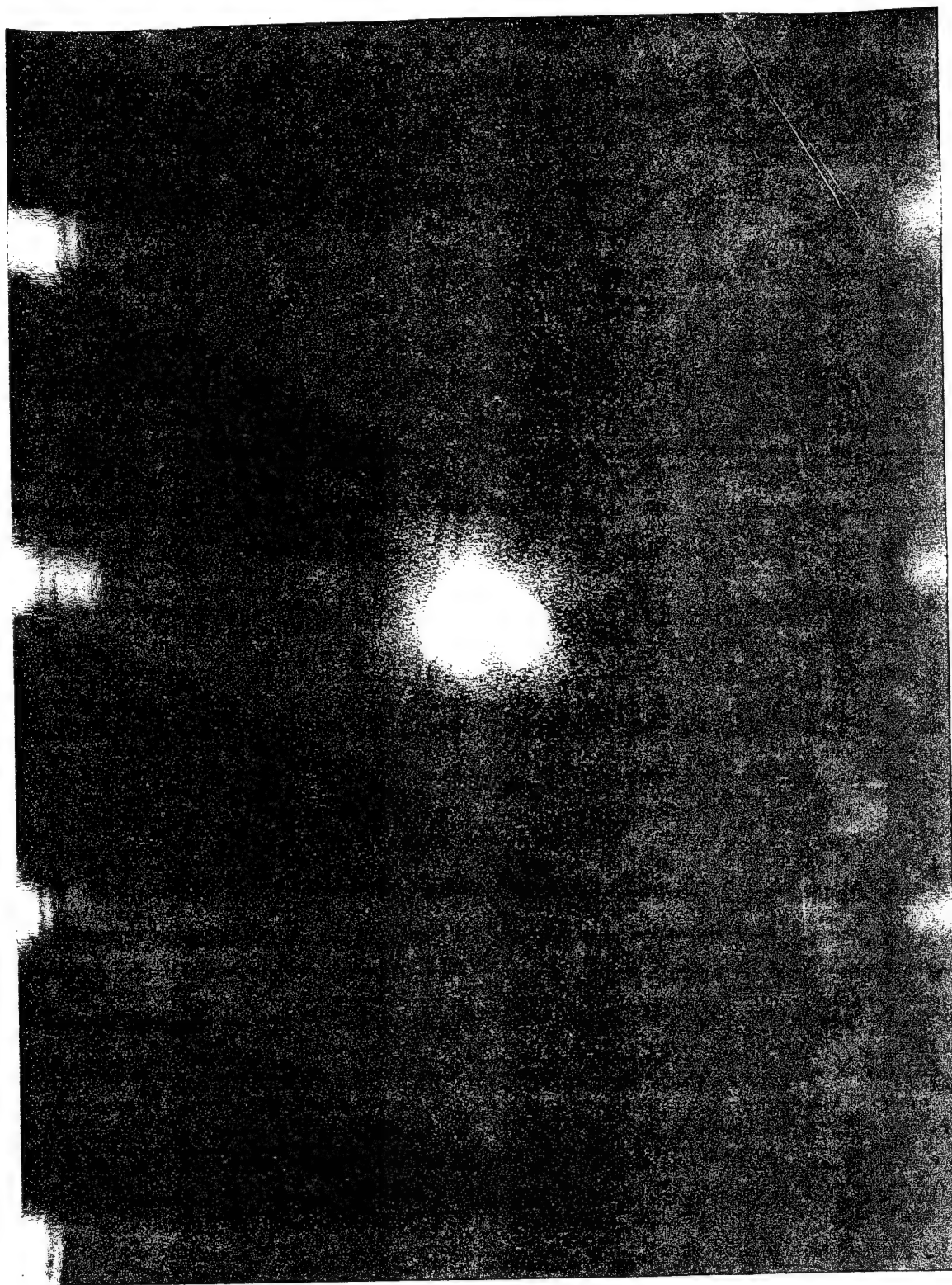
APPENDIX A  
HARDTACK PHASE II, HUMBOLDT  
PHOTOGRAPHIC EXAMPLES



Camera: Rapatronic-30

Station: 3-357

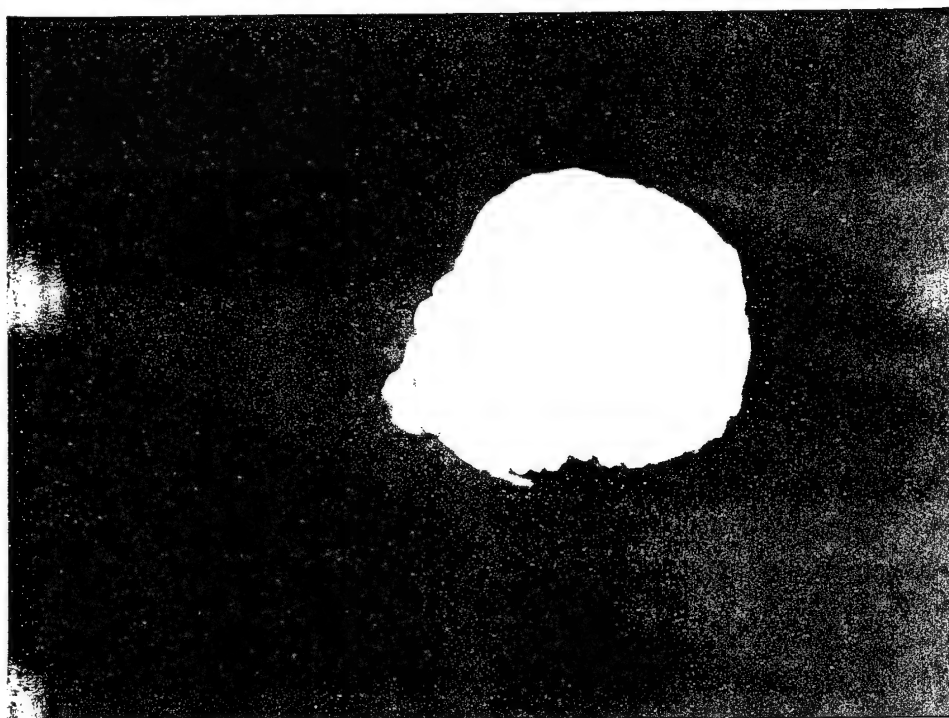
Time: 0.05 msec



Camera: XR-3

Station: 3-358

Time: 0.10 msec



Camera: E-1

Station: 3-357

Time: 0.48

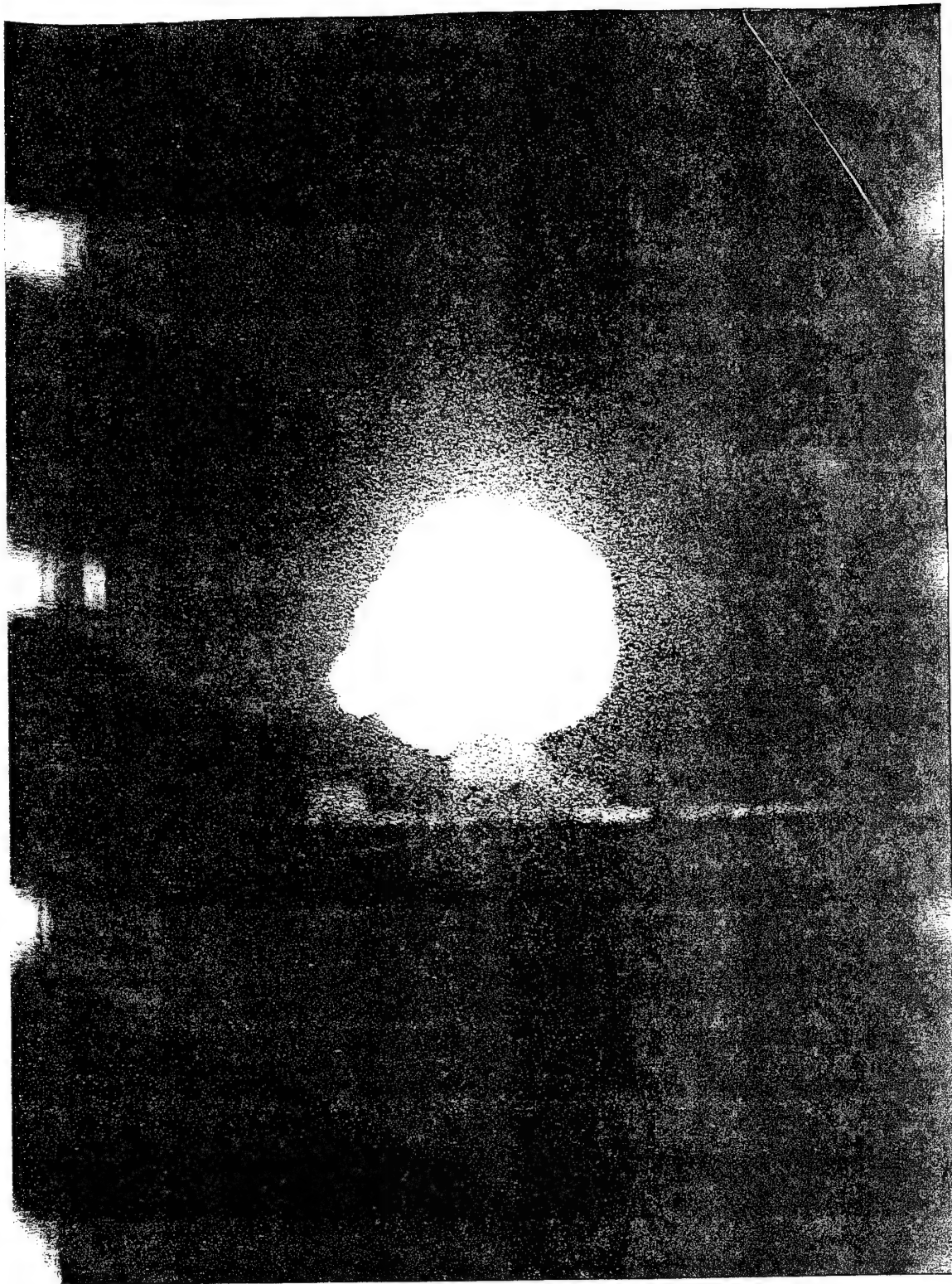


Camera: E-11

Station: 3-358 (White Truck No. 2)

Time: 0.76 msec

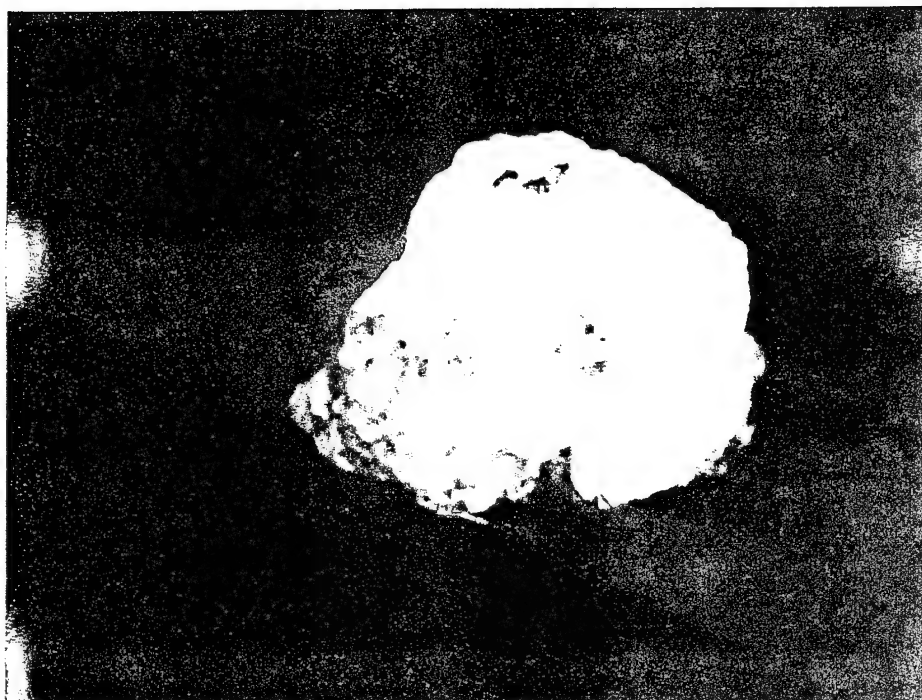




Camera: Rapatronic R-34

Station: 3-357

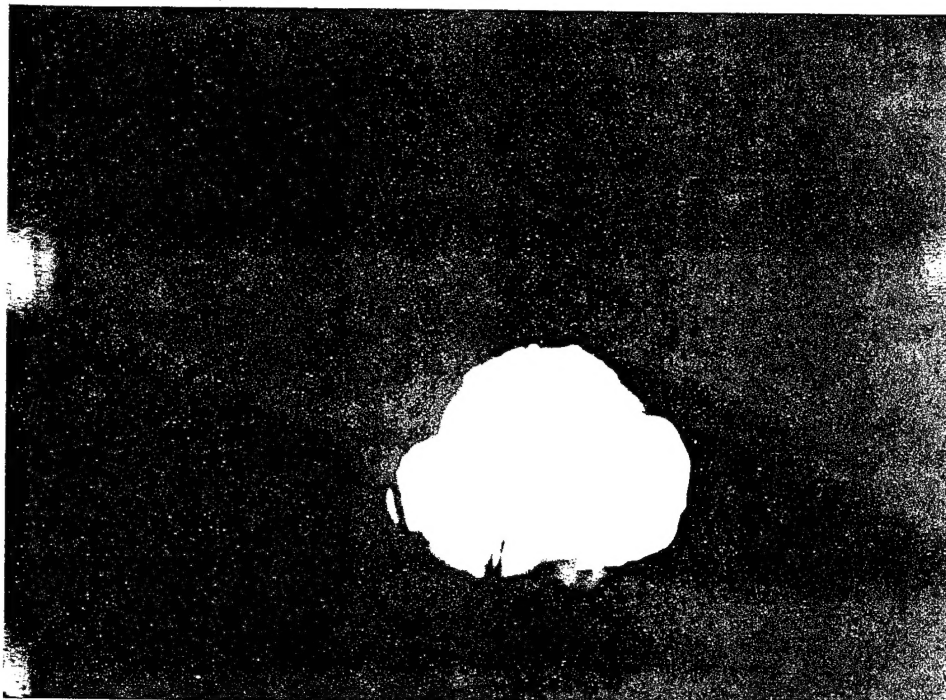
Time: 0.99 msec



Camera: E-1

Station: 3-357

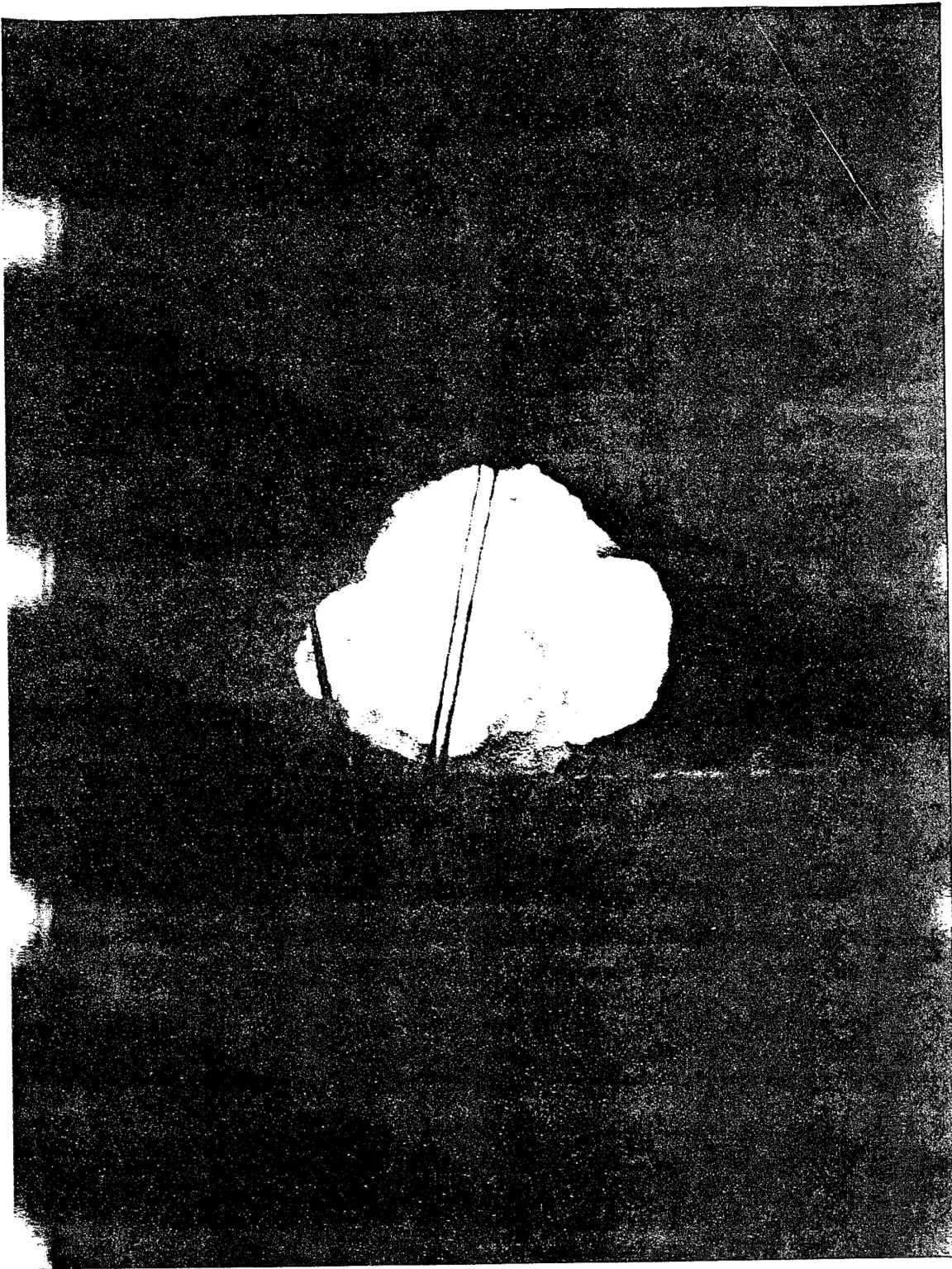
Time: 1.63 msec



Camera: E-5

Station: 3-358

Time: 2.94 msec



Camera: R-4

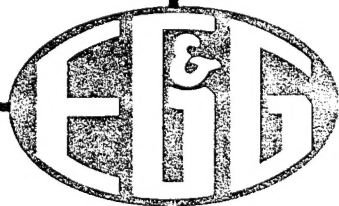
Station: 3-358

Time: 3.15 msec

Distribution

Copies to:

1	Dr. G. W. Johnson, Test Director
1	Dr. H. B. Keller, LRL Test Group Director
1	Dr. W. E. Ogle, LASL Test Group Director
1	Dr. L. S. Wouters, LRL
1	Dr. J. F. Mullaney, Group J-10
1	D. W. King, ALO
1	EG&G, Boston
1	EG&G, Las Vegas



**EDGERTON, GERMESHAUSEN & GRIER, INC.**

*Boston, Massachusetts • Las Vegas, Nevada*

*Santa Barbara, California*